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BAKER (MICHAEL) JR INC BEAVER PA
NATIONAL DAM SAFETY PROGRAM. LAKE HERITAGE DAM (INVENTORY NUMBER--ETC(U))
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LAKE HERITAGE DAM

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YORK RIVER BASIN.

LEVEL IV



Name of Dam: Lake Heritage Dam

Location: Caroline County, Commonwealth of Virginia

Inventory Number: VA 03332

PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM.

Lake Heritage Dam (Inventory Number VA-03332),
York River Basin. Caroline County,
Commonwealth of Virginia. Phase I Inspection
Report.



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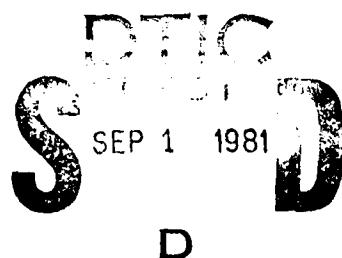
20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Inspection is to indentify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspection. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam appurtenenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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NAME OF DAM: LAKE HERITAGE DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Heritage Dam
State: Commonwealth of Virginia
County: Caroline
USGS 7.5 Minute Quadrangles: Ladysmith, Virginia and
Hewlett, Virginia
Stream: Unnamed Tributary to Stevens Mill Run
Date of Inspection: 27 October 1980

BRIEF ASSESSMENT OF DAM

Lake Heritage Dam is an earthfill embankment approximately 19.8 feet high¹ and 1,310 feet long with a 29.9 foot wide by 4 foot high concrete weir spillway situated about 40 feet from the right² abutment of the dam. The dam, located about 2.5 miles west of Ladysmith, Virginia, is used for recreation. The dam is owned by the Lake Land'or Property Owner's Association, Box 123, Ladysmith, Virginia 22501. Lake Heritage Dam is a "small" size - "high" hazard structure as defined by the Recommended Guidelines for Safety Inspection of Dams. The dam and appurtenant structures were in fair overall condition at the time of inspection. Maintenance of the dam is considered to be inadequate. A stability check of the dam is not required.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 1/2 Probable Maximum Flood (1/2 PMF) was selected as the spillway design flood (SDF). The SDF was routed through the reservoir and found to overtop the dam by a maximum depth of 0.7 feet with an average critical velocity of 3.8 feet per second. Total duration of overtopping would be approximately 1.9 hours. - The spillway is capable of passing 34 percent of the Probable Maximum Flood or 68 percent of the SDF without overtopping the crest of the dam. The spillway is adjudged as inadequate, but not seriously inadequate. The spillway has not been adjudged as seriously inadequate because, although the dam is overtopped by the 1/2 PMF, the depth, duration, and rate of overtopping flows are not considered detrimental to the embankment.

¹Measured from the streambed at the downstream toe to the embankment crest.

²Facing downstream.

NAME OF DAM: LAKE HERITAGE DAM

Regular inspections should be made of the dam and appurtenant structures. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be completed annually.

A formal warning system and emergency action plan should be developed and put into effect as soon as possible.

The following repair items should be accomplished as part of the general maintenance of the dam:

- 1) Remove all small trees and repair, regrade and reseed all eroded areas on the downstream embankment.
- 2) Remove all trees and brush from the emergency drain outlet area and riprap around the outlet.
- 3) The riprap size in the downstream spillway discharge channel should be checked against the design velocity size gradation and larger riprap installed as required.
- 4) The concrete block wall on the right side of the spillway discharge channel should be monitored for signs of movement or deterioration.
- 5) Choke off the riprap on the left side of the spillway discharge channel with finer material.
- 6) Place riprap in the drainage channel at the toe wherever the channel is in contact with or in close proximity to the toe of the embankment.
- 7) Monitor the roadway drainage channels on the right side of the embankment for erosion.
- 8) Install a staff gage to monitor reservoir levels above normal pool.

NAME OF DAM: LAKE HERITAGE DAM

MICHAEL BAKER, JR., INC.

SUBMITTED:


Michael Baker, III, P.E.
Chairman of the Board and
Chief Executive Officer



Original signed by
JAMES A. WALSH

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Chief, Engineering

RECOMMENDED:

Original signed by:
Douglas L. Haller

Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

APPROVED:

Original signed by:
Douglas L. Haller

JAN 10 1981

Date:

NAME OF DAM: LAKE HERITAGE DAM

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OVERALL VIEW OF DAM

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: LAKE HERITAGE DAM ID# VA 03332

SECTION 1 - PROJECT INFORMATION

1.1 General

- 1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.
- 1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

- 1.2.1 Description of Dam and Appurtenances: Lake Heritage Dam is an earthfill embankment approximately 19.8 feet high¹ and 1,310 feet long (Photo 5). The upstream and downstream embankment slopes are both approximately 2.6H:1V (Horizontal to Vertical). The crest of the dam is 27 feet wide. There is no accurate information available on any possible zoning of the embankment. However, construction plans, obtained from the developer's representative, depict a 20 foot wide key trench. No evidence of an internal drainage system for the dam was found. The upstream embankment slope is riprapped.

The spillway is a 29.9 foot wide by 4 foot high by 1 foot thick concrete weir (Photo 1). The spillway is located approximately 40 feet

¹Measured from the downstream toe of the embankment to the crest of the embankment at the maximum cross section of the dam.

NAME OF DAM: LAKE HERITAGE DAM

from the right² abutment of the dam. The crest of the weir is at elevation 237.0 feet Temporary Bench Mark (T.B.M.)³. The discharge channel is a paved concrete splash apron with a bottom width of approximately 30 feet and side slopes of approximately 2.5H:1V. The concrete splash apron is approximately 30 feet long (Photo 1). The discharge channel downstream of the concrete apron is rock riprap and concrete rubble for approximately 54 feet then natural channel (Photo 2). A 3 foot high by 8 inch wide concrete block retaining wall borders the right side of the paved section of the discharge channel (Photo 2). From the crest of the weir there is a 2 foot vertical drop to the splash apron at elevation 235.0 feet T.B.M. The downstream end of the splash apron is at elevation 234.8 feet T.B.M. The 54 foot long riprap and concrete rubble section of the discharge channel drops another 0.8 feet to an elevation of 234.0 T.B.M. The natural section of the discharge channel drops an additional 7.9 feet to an elevation of 226 feet T.B.M. The discharge then flows into an unnamed tributary and thence into Stevens Mill Run at Lake Caroline.

The reservoir is fed by runoff from a small drainage area to the west of the dam. The upper reaches of this watershed are primarily open woodlands with scattered farmland. The lower reaches of the watershed, immediately surrounding Lake Heritage, are the site of the Lake Land'or residential community project (Photo 8). While present development is limited to just a few residences, the area has been subdivided into hundreds of lots creating the potential for considerable residential development.

An emergency drain has been provided for dewatering the reservoir. An 18 inch bituminous coated corrugated metal outlet pipe, with nine concrete antiseep collars, has been installed through the embankment approximately

²Facing downstream.

³All elevations are referenced to a Temporary Bench Mark located on the outside rim of a water manhole near the intersection of Kent Drive and Heritage Drive. The assumed elevation is 254.2 feet.

NAME OF DAM: LAKE HERITAGE DAM

450 feet from the right abutment of the dam. An 18 inch gate valve with accompanying valve stem support tower and hand wheel controls the discharge into the emergency drain (Photo 3). The invert at the outlet of the drain is at elevation 221.0 feet T.B.M. The length and slope of the drain are estimated to be 137 feet and 1.9 percent respectively (Photo 4).

- 1.2.2 Location: Lake Heritage Dam is located in Caroline County, Virginia approximately 2.5 miles west of Ladysmith, Virginia and approximately 0.75 mile south of VA Route 639. The dam is situated on an unnamed tributary to Stevens Mill Run approximately 0.75 miles upstream from Lake Caroline, in the Lake Land'or residential community project. A Location Plan is included in this report in Appendix 1.
- 1.2.3 Size Classification: The height of Lake Heritage Dam is 19.8 feet; the reservoir storage capacity at the crest of the dam (elevation 242.3 feet T.B.M.) is 494 acre-feet. Therefore, the dam is in the "small" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.
- 1.2.4 Hazard Classification: A two-lane, tar and chip roadway runs along the crest of the dam. This road provides access to a portion of the Lake Land'or development. Three land parcels, from the development, are available for home construction on the left downstream side of the dam. A sewage treatment plant is situated immediately downstream of the embankment. Approximately one mile downstream, VA Route 683 crosses the upper reaches of Lake Caroline and a pump station is located adjacent to this road in Lake Caroline. There is danger of loss of human life from large flows downstream of the dam. Lake Heritage Dam is therefore considered to be in the "high" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of location only and is not related to its stability or probability of failure.

NAME OF DAM: LAKE HERITAGE DAM

- 1.2.5 Ownership: The dam is owned by the Lake Land or Property Owner's Association, Box 123, Ladysmith, Virginia 22501.
- 1.2.6 Purpose: The dam was constructed for recreational purposes.
- 1.2.7 Design and Construction History: Lake Heritage Dam was constructed in 1974 by J. R. Houston. The dam was engineered by L. Dexter Hubbard, Jr. of Fredericksburg, Virginia. Mr. Hubbard provided copies of the dam design plans and a photograph of the construction (see Plates 2, 3 and 4). No other information on design and construction history was available.
- 1.2.8 Normal Operational Procedures: The reservoir is normally operated at the crest of the control section of the spillway, elevation 237.0 feet T.B.M. No formal operating procedures are followed for this structure.

1.3 Pertinent Data

- 1.3.1 Drainage Area: The drainage area tributary to the dam is 0.93 square miles.
- 1.3.2 Discharge at Dam Site: The maximum discharge from the reservoir is unknown. With the pool level at the top of dam the spillway is capable of passing a discharge of 1219 c.f.s.
- 1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are provided in the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation (feet T.B.M.)	Reservoir Capacity			
		Area (acres)	Acre- feet	Watershed (inches)	Length (feet)
Top of Dam (minimum)	242.3	74.8	494	10.0	3200
Spillway Crest (normal pool)	237.0	42.2	188	3.8	2800
Streambed at downstream toe of dam	221.0	-	-	-	-

NAME OF DAM: LAKE HERITAGE DAM

SECTION 2 - ENGINEERING DAM

- 2.1 Design: Design plans for Lake Heritage Dam were obtained from the designer, L. Dexter Hubbard, Jr. of Fredericksburg, Virginia. A hydrologic analysis of the Lake Heritage watershed was performed in 1976 by Mr. Hubbard to determine if the design spillway was adequate to pass the 100 year flood, as determined at that time (peak discharge of 380 c.f.s.). The results of this analysis were stated in a letter, dated 13 April 1976, from Mr. Hubbard to First United Corporation, the original development company for Lake Land'or. No engineering support data were provided for this analysis. No other plans, specifications or boring logs were available for use in preparing this report. No stability analyses or other hydrologic and hydraulic data were available for review.
- 2.2 Construction: The dam was constructed in 1974 by Mr. J. R. Houston. Construction records, as-built plans, and inspection logs were not available for review. However, during the inspection a photograph showing the emergency drain installation and concrete antiseep collars was obtained.
- 2.3 Evaluation: No construction records or as-built plans were available to adequately assess the condition of the dam. All evaluations and assessments in this report are based on field observations, conversations with representatives of the owners and office analyses.

NAME OF DAM: LAKE HERITAGE DAM

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SECTION 3 - VISUAL INSPECTION

3.1 Findings

- 3.1.1 General: The field inspection was conducted 27 October 1980. At the time of the inspection, the pool elevation was at 236.3 feet T.B.M.; the tailwater elevation was 221.6 feet T.B.M.; and the weather was clear with the temperature at 50 degrees Fahrenheit. The ground surface at the embankment and abutments was generally dry. The dam and appurtenant structures were found to be in fair to good overall condition at the time of the inspection. Deficiencies found during the inspection will require remedial treatment. The following are brief summaries of deficiencies found during the inspection. A Field Sketch of conditions found during the inspection is presented as Plate 1 in Appendix 1. The complete visual inspection check list is included as Appendix III. No record of any previous inspections was found.
- 3.1.2 Dam: The embankment was found to be in generally fair condition. The downstream embankment slope was moderately eroded and sparsely vegetated with grass (Photo 6). The right end of the downstream embankment was the most severely eroded. Small evergreen trees have seeded into the embankment. The upstream embankment was riprapped to the crest of the dam and in good condition. No evidence of an internal drainage system was found during the inspection.
- The toe of the downstream embankment has been slightly eroded by local runoff that is channeled left to right between the dam and sewage treatment plant, situated immediately downstream of the dam. A swampy area was noted along the toe of the dam. This is believed to be related to the runoff that drains left to right along the toe.
- 3.1.3 Appurtenant Structures: The spillway approach channel and discharge channel (as described in Section 1.2.1) were found to be in good condition at the time of inspection. The approach channel was not clogged and was

NAME OF DAM: LAKE HERITAGE DAM

well riprapped (Photos 1 and 2). The spillway was clear of debris and no indications of spalling concrete were found. The discharge channel was not clogged and the concrete splash apron showed no signs of cracking or spalling (Photo 1). The left side of the discharge channel was lined with riprap. The right side of the discharge channel was lined with a 3 foot high concrete block retaining wall (Photo 2). This wall was leaning slightly towards the discharge channel at the time of inspection. The downstream discharge channel is lined with broken concrete and riprap but this material shows some signs of washout from previous storms.

The emergency drain was found to be in corroded condition at the time of inspection. The valve stem support tower was in poor condition. The steel valve stem was very corroded and the operation of the valve is questionable (Photo 3). The emergency drain outlet, an 18 inch corrugated metal pipe, was partially submerged in a standing pool of water which was approximately 0.7 feet deep at the time of inspection. This emergency drain discharge area was not protected with riprap and was overgrown with high grass and small trees (Photo 4). The downstream channel is wooded.

3.1.4

Reservoir Area: The slopes surrounding the reservoir are very gentle. The area immediately surrounding the reservoir is the site of large scale residential development called Lake Land'or. A few residences had been constructed at the time of the inspection, but the area was still primarily woodlands with some open, grassy spots. The banks of the reservoir were well vegetated with medium to tall grasses and some trees. No indication of any significant erosion was noted. The extent of sedimentation was not directly observed, but it is not expected to be significant. Soundings taken at the time of inspection show the depth to be about 12 feet at a spot approximately 100 feet offshore from the approximate center of the embankment.

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- 3.1.5 Downstream Channel: The downstream channel is the old stream channel. It is overgrown with brush and the floodplains are generally wooded. The channel has a slope of approximately 0.5 percent. There are no major obstructions or debris.
- 3.1.6 Instrumentation: There was no instrumentation at the dam site at the time of inspection.
- 3.2 Evaluation: In general, the dam and appurtenant structures were in fair overall condition. The downstream embankment should be cleared of small trees and all eroded areas should be repaired, regraded and reseeded. The drainage channel at the toe should be riprapped to minimize erosion wherever the channel is in contact with or in close proximity to the toe of the embankment (Photo 7). The riprap on the left side of the spillway discharge channel should be choked off with finer material. The concrete block wall on the right side should be checked periodically for movement or deterioration. The riprap size in the downstream discharge channel should be checked against the design velocity size gradation and larger riprap installed as required. The outlet area for the emergency drain should be cleared of brush and trees and riprapped to minimize erosion (Photo 4). A staff gage should be installed to monitor reservoir levels above normal pool.

NAME OF DAM: LAKE HERITAGE DAM

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SECTION 4 - OPERATIONAL PROCEDURES

- 4.1 Procedures: The operation of the dam is an automatic function controlled by the crest of the spillway at elevation 237.0 feet T.B.M.
- 4.2 Maintenance of Dam: Maintenance of the dam is the responsibility of the owner. An inspection and maintenance schedule has not been instituted.
- 4.3 Maintenance of Operating Facilities: The only operating facility at the dam at the time of inspection was the emergency drain. The maintenance of this operating facility is the responsibility of the owner. An inspection, testing or maintenance schedule has not been instituted.
- 4.4 Warning System: At the time of inspection, there was no warning system or emergency action plan in operation.
- 4.5 Evaluation: Maintenance of the dam in the past has been inadequate. Regular inspections should be made of the dam and appurtenant structures. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be corrected annually. In addition, a formal warning system and emergency action plan should be developed and put into operation as soon as possible.

NAME OF DAM: LAKE HERITAGE DAM

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SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

- 5.1 Design: No hydraulic or hydrologic design data were available for use in preparing this report.
- 5.2 Hydrologic Information: No rainfall, stream gage or reservoir stage records were maintained for this dam.
- 5.3 Flood Experience: No records were available.
- 5.4 Flood Potential: The Probable Maximum Flood (PMF) and 1/2 Probable Maximum Flood (1/2 PMF) were developed and routed through the reservoir by use of the HEC-1 DB computer program (Reference 9, Appendix IV) and appropriate unit hydrograph, precipitation and storage-outflow data. Clark's I_c and R coefficients for the local drainage areas were estimated from the basin characteristics. The rainfall applied to the unit hydrograph was taken from a publication by the National Oceanic and Atmospheric Administration (Reference 17, Appendix IV). Rainfall losses for the PMF and 1/2 PMF were estimated at an initial loss of 1.0 inches and a constant loss rate of 0.05 inches per hour thereafter.
- 5.5 Reservoir Regulation: Pertinent dam and reservoir data are provided in Table 1.1, Paragraph 1.3.3.

Regulation of flow from the reservoir is automatic. Normal pool level is maintained by the invert of the control section of the spillway which is at elevation 237.0 feet T.B.M.

The outlet discharge capacity was computed by hand; reservoir area was planimetered from the Ladysmith, Virginia and Hewlett, Virginia, 7.5 minute USGS quadrangles; and storage capacity curves were computed to elevations above the crest of the dam. All flood routings were begun with the reservoir at normal pool.

- 5.6 Overtopping Potential: The probable rise of the reservoir and other pertinent information on reservoir performance are shown in the following table:

NAME OF DAM: LAKE HERITAGE DAM

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal ¹	Hydrographs	
		1/2 PMF	PMF ²
Peak flow, c.f.s.			
Inflow	0	4108	8216
Outflow	0	2715	7863
Peak elev., ft. T.B.M.	236.3	243.0	243.9
Non-overflow section ³ (elev. 242.3 ft. T.B.M.)			
Depth of flow, ft.	-	0.7	1.6
Average velocity, f.p.s.	-	3.8	5.8
Total duration of over- topping, hrs.	-	1.9	3.6
Tailwater elev., ft. T.B.M.	221.6	-	-

¹ Conditions at time of inspection.

² The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in a region.

³ Velocity estimates were based on critical depth at control section.

5.7 Reservoir Emptying Potential: The reservoir can be drawn down by means of an 18 inch emergency drain. Neglecting inflow, the reservoir can be drawn down from normal pool in approximately 6.8 days. This is equivalent to an approximate drawdown rate of 2.0 feet per day, based on the hydraulic height measured from normal pool divided by the time to dewater the reservoir.

5.8 Evaluation: Lake Heritage Dam is a "small" size - "high" hazard dam requiring evaluation for a spillway design flood (SDF) in the range between the 1/2 PMF and the PMF. Due to the risk involved, the 1/2 PMF has been selected as the SDF. The SDF was routed through the reservoir and found to overtop the dam by a maximum depth of 0.7 feet with an average critical velocity of 3.8 feet per second (f.p.s.). Total duration of dam overtopping would be 1.9 hours. The spillway is capable of passing up to 68 percent of the SDF or 34 percent of the PMF without overtopping the crest of the dam.

Conclusions pertain to present-day conditions and the effect of future development on the hydrology has not been considered.

NAME OF DAM: LAKE HERITAGE DAM

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: No previous information was available for the visual inspection or subsequent analyses describing local subsurface conditions. The dam is located along the border separating the Piedmont and the Coastal Plain physiographic provinces. The topography of the Piedmont generally consists of rolling hills and gentle slopes with relief less than 150 feet. Granite gneiss of uncertain age is shown on the State geologic map as underlying the dam. Bedrock outcrops were not observed in the area of the dam during the field inspection. A 20 foot wide key approximately 15 feet deep was excavated into the foundation materials slightly upstream of the dam crest according to available design drawings and conversations with the developer's representative. Relatively thick combination residual, alluvial soils are expected to be present beneath the dam. The Piedmont physiographic province is reported to contain widespread, thick (50-150 feet) residual soils.

6.2 Embankment

6.2.1 Materials: Documented information describing the nature of the embankment materials or any zoning within the dam was not available for this inspection. During the field inspection, the outer embankment materials were determined to be comprised of red to brown sandy silt with quartz fragments (ML group soil- Unified Classification System). These materials appear to have been obtained locally and are derived largely from weathering of the underlying gneiss.

6.2.2 Stability: The results of a previous stability analysis were not available for reference during this evaluation. General design plans were obtained from the original developer, but they did not indicate zoning of the dam. Thus, the embankment is assumed to be a generally homogeneous type. The dam is 21.3 feet high with a crest width of 27 feet. The upstream slope of the dam is shown on the available plans to be 3H:1V with a 5 foot wide bench situated 2 feet below normal pool level. However, the field survey measured the upstream slope as 2.6H:1V. The downstream slope is reported to be 2.5H:1V, but

NAME OF DAM: LAKE HERITAGE DAM

was measured as being slightly flatter (2.6H:1V). According to hydraulic calculations made as part of this evaluation, the dam is subject to a rapid drawdown rate of 2.0 feet per day which exceeds the critical rate of 0.5 feet per day for earth dams.

Signs of instability in the embankment such as slumping, tension cracks, or unusual alignment along the crest were not observed during the visual inspection. The lower section of the downstream embankment was generally dry even though an internal drainage system was not provided. No seepage through the embankment or along the toe of the dam was observed. The entire downstream embankment (particularly the right side) is sparsely vegetated and moderately eroded. The toe of the downstream embankment near the center of the dam has been eroded slightly by local runoff that is channeled between the dam and the sewage treatment plant that is situated immediately downstream of the dam (see Plate 1 and Photo 7). The channel is a few feet deep locally.

According to guidelines outlined in Design of Small Dams by the U.S. Department of the Interior, Bureau of Reclamation, the upstream slope of a small homogeneous dam constructed of slightly plastic fine grained soils (ML, CL), with a stable foundation, should be 3.5H:1V if subject to rapid drawdown. The downstream slope recommended is 2.5H:1V. A crest width of 14.2 feet is recommended considering the height of the dam. Based on these guidelines the upstream slope is inadequate and the downstream slope and crest width are more than adequate.

6.2.3 Seismic Stability: The dam is located in Seismic Zone 2 which presents no hazard from earthquakes according to the Recommended Guidelines for Safety Inspection of Dams by the Department of the Army, Office of the Chiefs of Engineers. This determination is contingent on the requirements that static stability conditions are satisfactory and conventional safety margins exist.

NAME OF DAM: LAKE HERITAGE DAM

6.3 Evaluation: Though the results of a previous stability analysis were not available for comparison as part of this evaluation, the Lake Heritage Dam showed no signs of instability based on the visual inspection. However, continued erosion of the downstream embankment and the toe of the dam will be detrimental in this respect. The upstream embankment is steep as compared to the Bureau of Reclamation guidelines. However, the crest is almost twice the width recommended and the upstream embankment is well riprapped which serves to stabilize the slope. The downstream embankment is slightly flatter than the slope recommended by the guidelines. Further evaluation of the stability is not considered necessary.

Despite the inability of the spillway to pass the SDF (as described in Section 5 of this report), the depth, duration, and rate of overtopping flows are not considered detrimental to the existing embankment. Overtopping flows are shallow and last only 1.9 hours, and the velocity is less than 6 f.p.s., the effective eroding velocity for a vegetated earth embankment. It is important to fill and seed erosion channels on the embankment.

NAME OF DAM: LAKE HERITAGE DAM

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SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

- 7.1 Dam Assessment: Design plans for the dam were reviewed, however no other engineering data were available for use in preparing this report. The engineering data available for review was inadequate. The dam and appurtenant structures were generally in fair overall condition at the time of the inspection. Deficiencies discovered during the field inspection and office analyses will require further investigation and remedial treatment. Maintenance of the dam is considered inadequate. There is no evidence of instability. Further evaluation of the stability is not considered necessary.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 1/2 PMF was selected as the SDF for the "small" size - "high" hazard classification of Lake Heritage Dam. It has been determined that the SDF would overtop the dam by a maximum depth of 0.7 feet with an average critical velocity of 3.8 feet per second. Total duration of the overtopping would be approximately 1.9 hours. The spillway is capable of passing up to 34 percent of the PMF or 68 percent of the 1/2 PMF without overtopping the non-overflow section of the dam. The spillway is adjudged as inadequate, but not seriously inadequate. The spillway has not been adjudged as seriously inadequate because, although the dam is overtopped by the 1/2 PMF, the depth, duration, and rate of overtopping flows are not considered detrimental to the embankment.

There is no warning system or emergency action plan currently in operation.

- 7.2 Recommended Remedial Measures: A formal warning system and emergency action plan should be developed and put into effect as soon as possible.

Regular inspections should be made of the dam and appurtenant structures. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be completed annually.

The following repair items should be accomplished as part of the general maintenance of the dam:

- 1) Remove all small trees and repair, regrade and reseed all eroded areas on the downstream embankment.

NAME OF DAM: LAKE HERITAGE DAM

- 2) Remove all trees and brush from the emergency drain outlet area and riprap around the outlet.
- 3) The riprap size in the downstream spillway discharge channel should be checked against the design velocity size gradation and larger riprap installed as required.
- 4) The concrete block wall on the right side of the spillway discharge channel should be monitored for signs of movement or deterioration.
- 5) Choke off the riprap on the left side of the spillway discharge channel with finer material.
- 6) Place riprap in the drainage channel at the toe wherever the channel is in contact with or in close proximity to the toe of the embankment.
- 7) Monitor the roadway drainage channels on the right side of the embankment for erosion.
- 8) Install a staff gage to monitor reservoir levels above normal pool.

NAME OF DAM: LAKE HERITAGE DAM

APPENDIX I

PLATES

CONTENTS

Location Plan

Plate 1: Field Sketch

Plate 2: Title Sheet (Design Plans)

Plate 3: Plan and Profile (Design Plans)

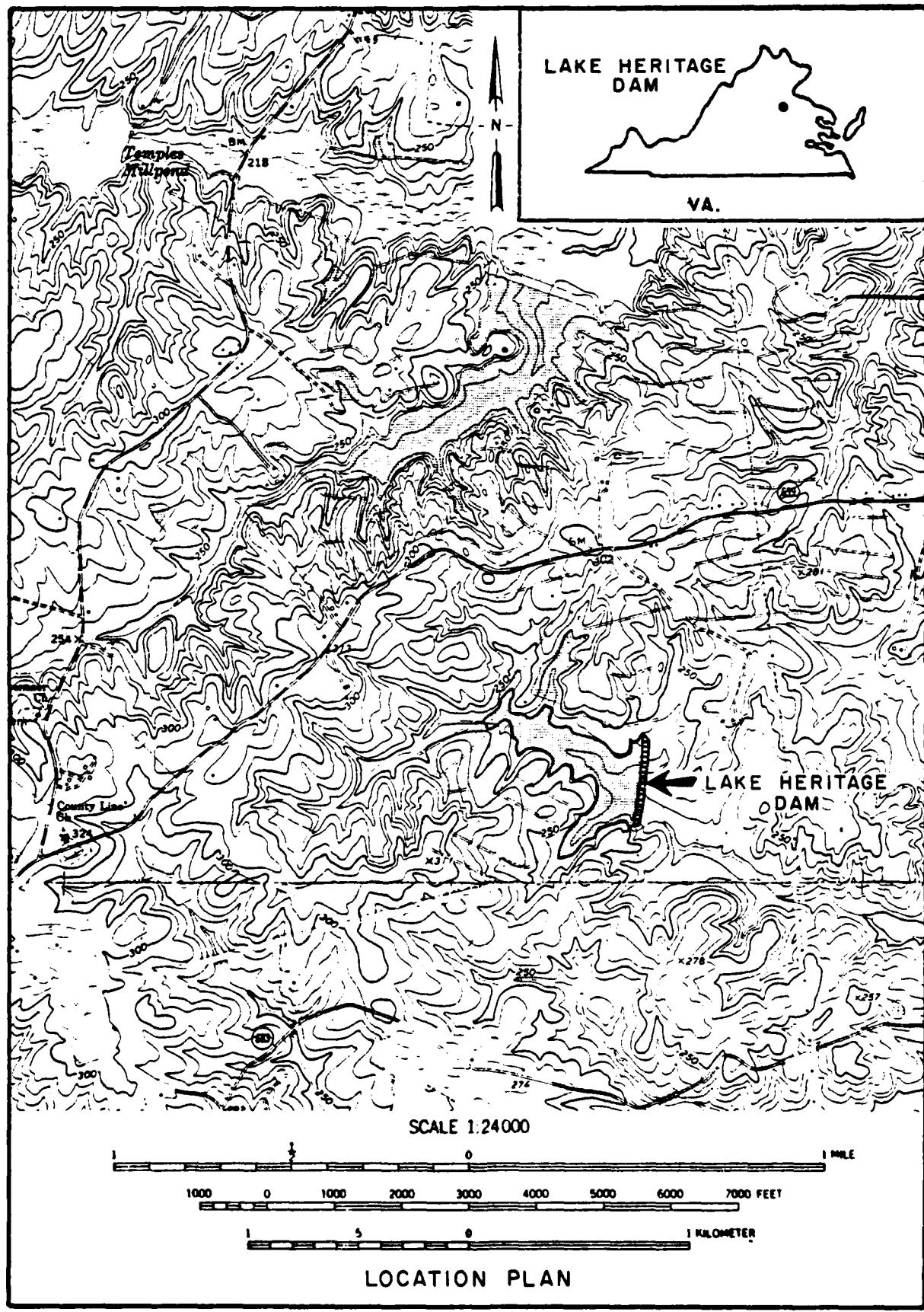
Plate 4: Typical Section, Drain Details (Design Plans)

Plate 5: Spillway, Plan and Profile (Design Plans)

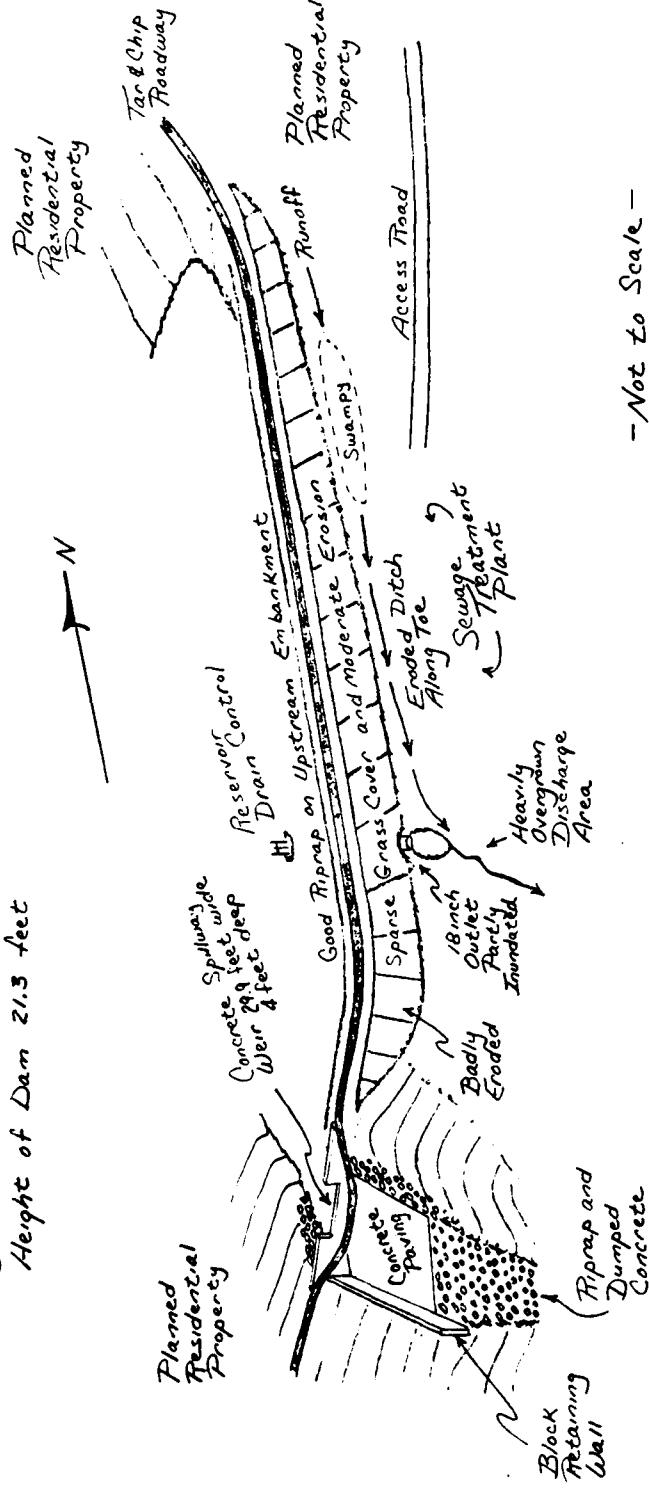
Plate 6: Details of Spillway, Wing Wall, and Splash Apron
(Design Plans)

Plate 7: Top of Dam Profile and Typical Cross Section
(Existing Field Conditions)

NAME OF DAM: LAKE HERITAGE DAM



Upstream & Downstream Slopes 2.6H:1V
Crest Width 27 feet
Height of Dam 21.3 feet



-Not to Scale -

FIELD SKETCH

LAKE HERITAGE DAM, VIRGINIA

Michael Baker, Jr., Inc.

27 October 1980

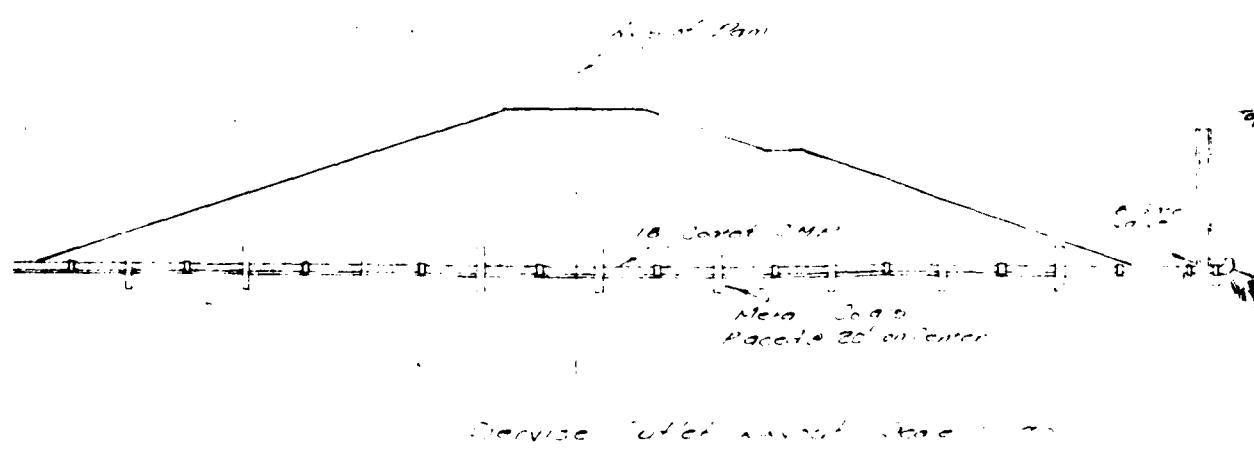
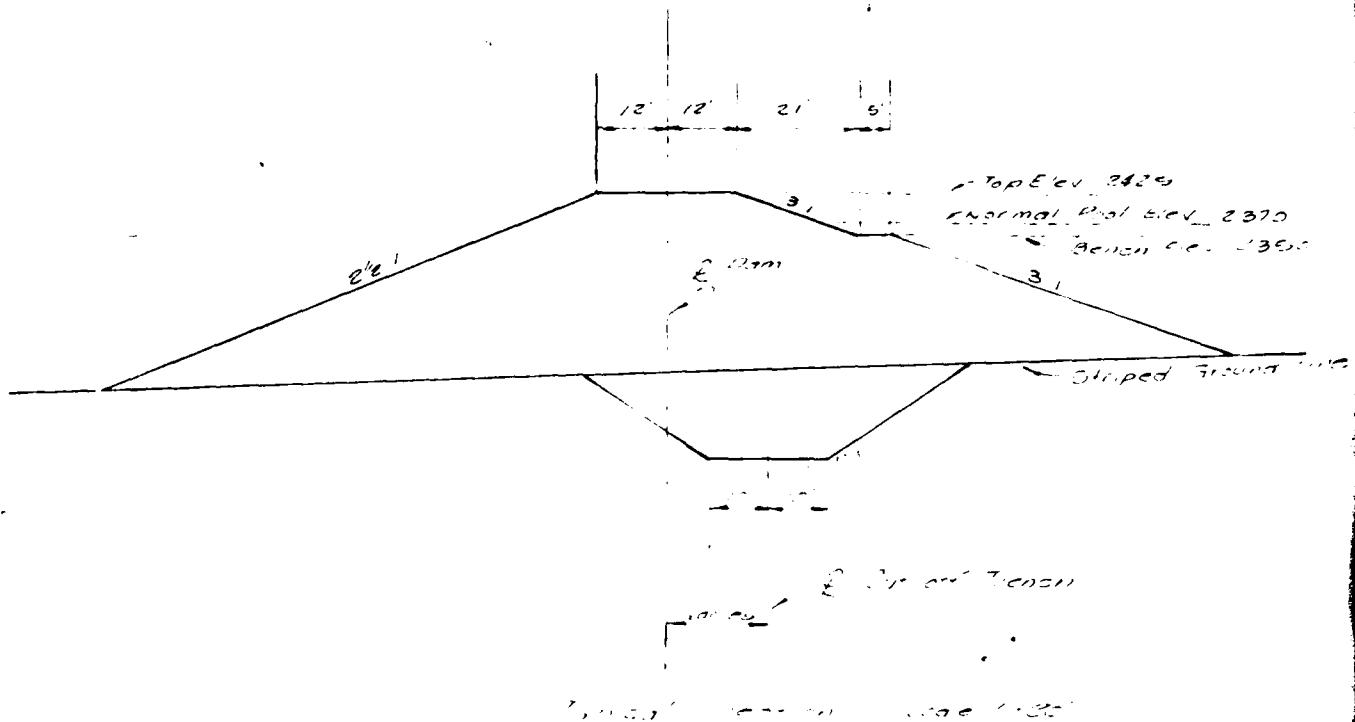
PLATE 1

LAKE LAN HERITAGE DA

CONSTRUCTION PLANS

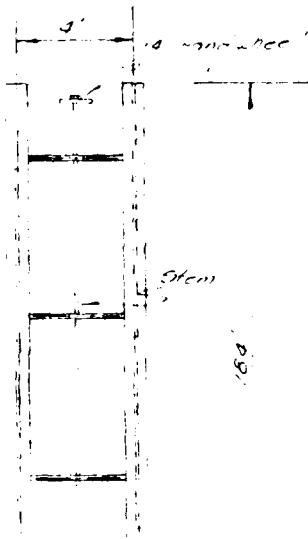
E LAND OR'
AGE DAM
STRUCTION PLANS

Plate 2



Top Elevation
Normal Head Elevation
Bench Elevation

Stripped Ground Surface



Top of Dam Face
Elevation

Metal 30' min
Soil 30' maximum

Level Stake 100'

Front Elevation

Plate 3

Top Plan Enlargement (Exaggerated)

Spillway Clear & even
Bench Elevation Spillway Spash

Profile of Dam
Scale 400' 1:100
vert 1:10'

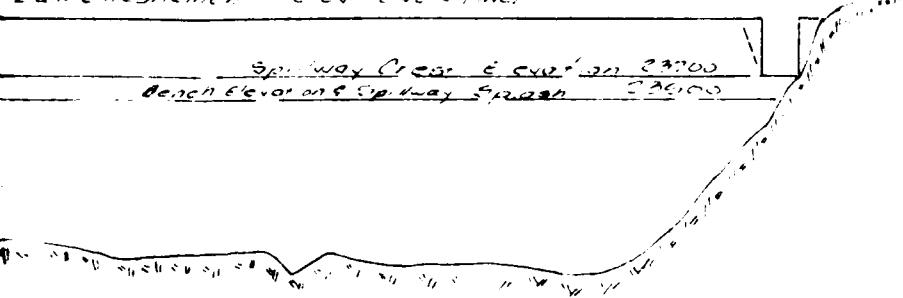
LAKE HERITAGE

Horizon View
Date 1970

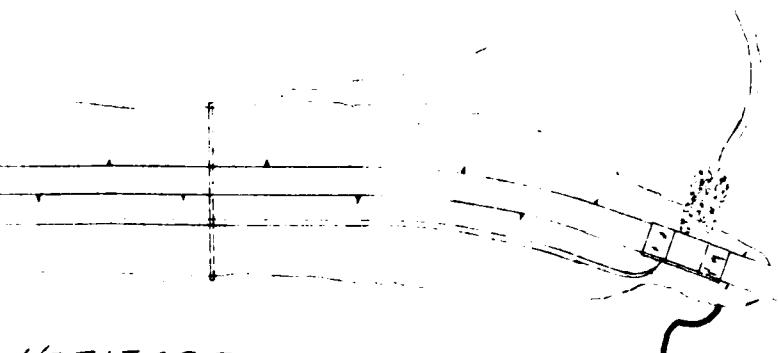
Dam Embankment elev 8850 ft (asl)

Spillway Crest elev' 201 23700

Bench elevation Spillway Spur 23600



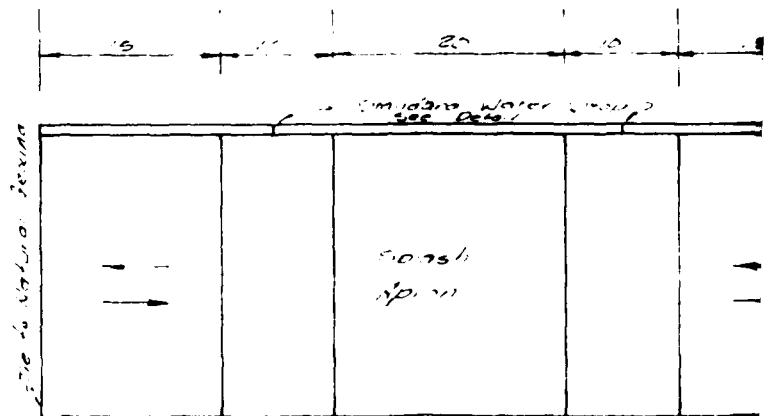
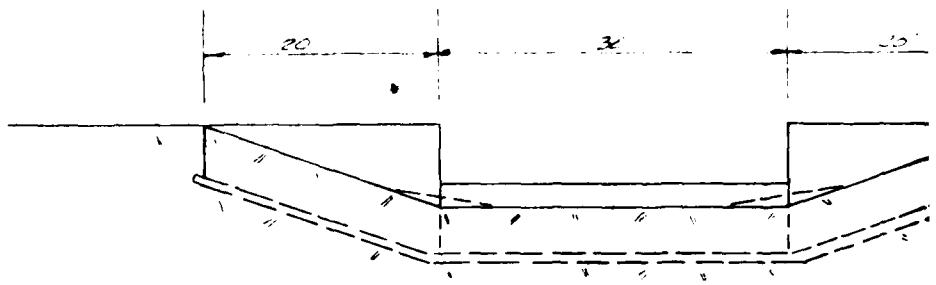
Profile of Dam
Scale Long 1:100
vert 1:10'



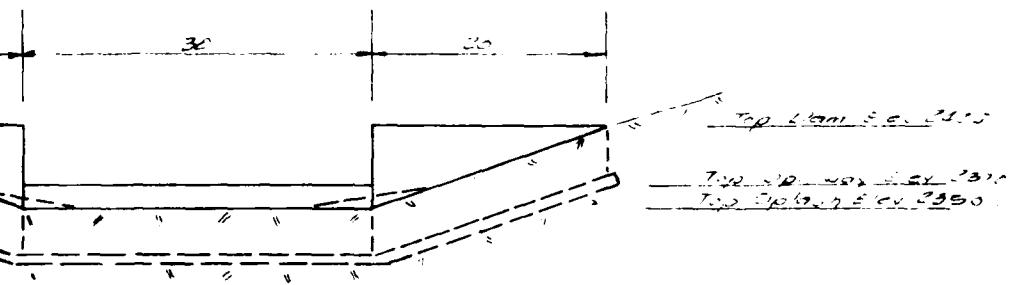
HERITAGE

Plan View
Scale 1:100

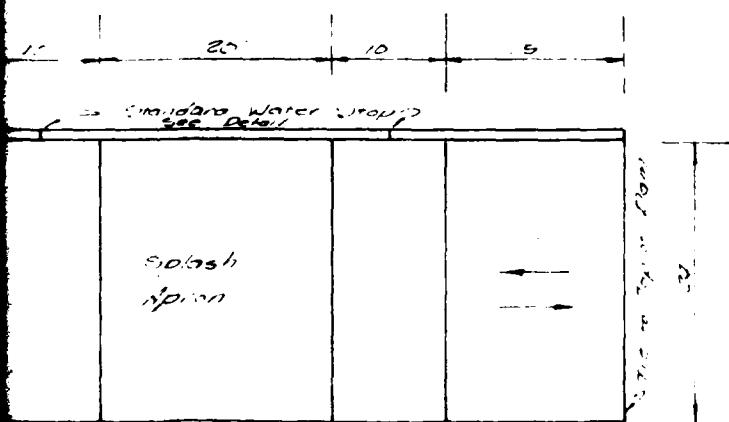
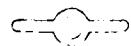
Plate 4



Spillway Vertical view scale



Spillway horizontal view scale 1:100



1:100

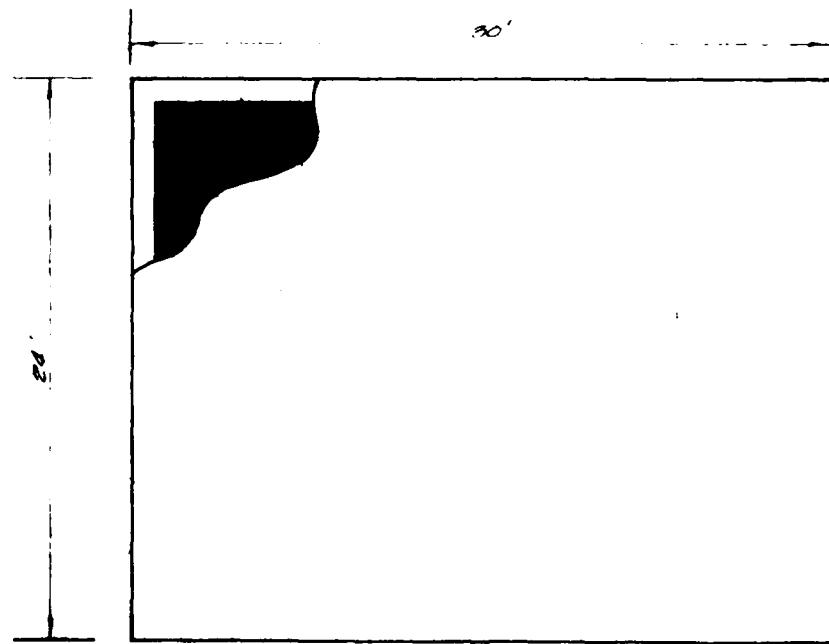
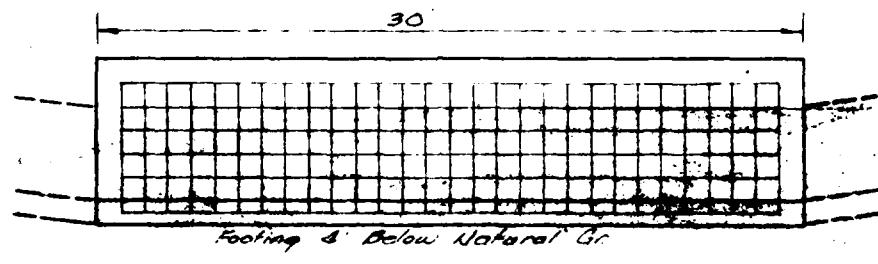
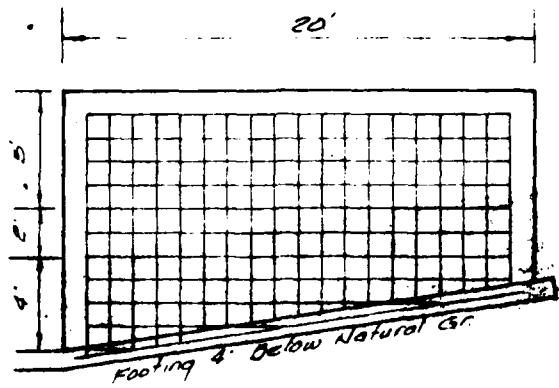
Top Spillway water elevation
no detail

dimensions

R.O. Top

Spillway Vertical View Scale 1:100

Page 5

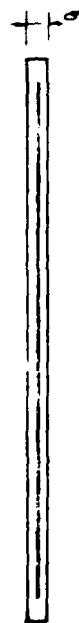




Wingwall Detail
No 5 Reinforcement Bars 18" on Center
Scale 1 : 8'



Splitwall Detail
No 5 Reinforcement Bars 18" on Center
Scale 1 : 8'

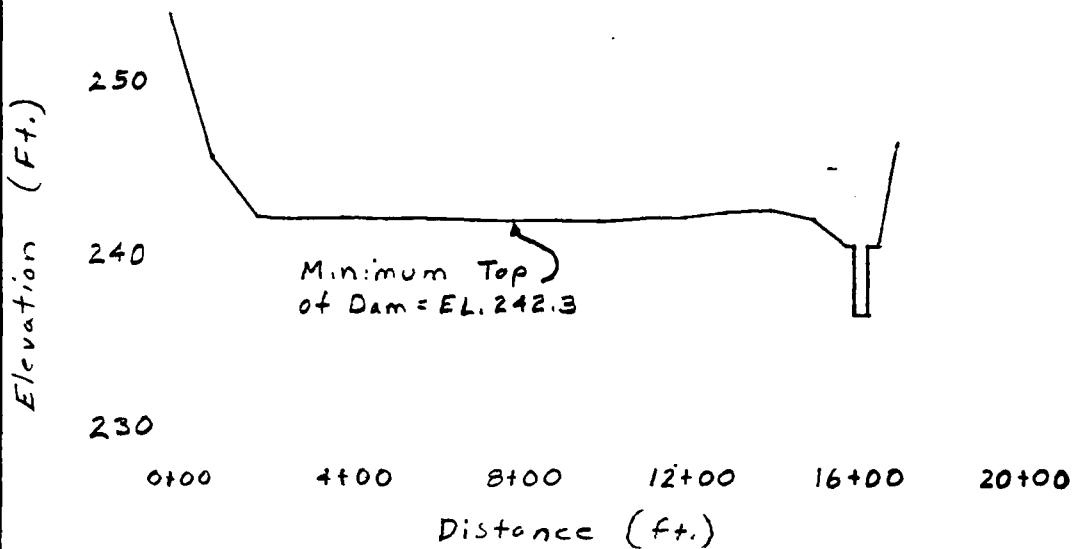


Dolos Detail
One 18" Reinforcement
Bar 1 : 8'

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Top of Dam Profile Looking Downstream



Dam Cross Section at Outlet Works
Sta. 12+00

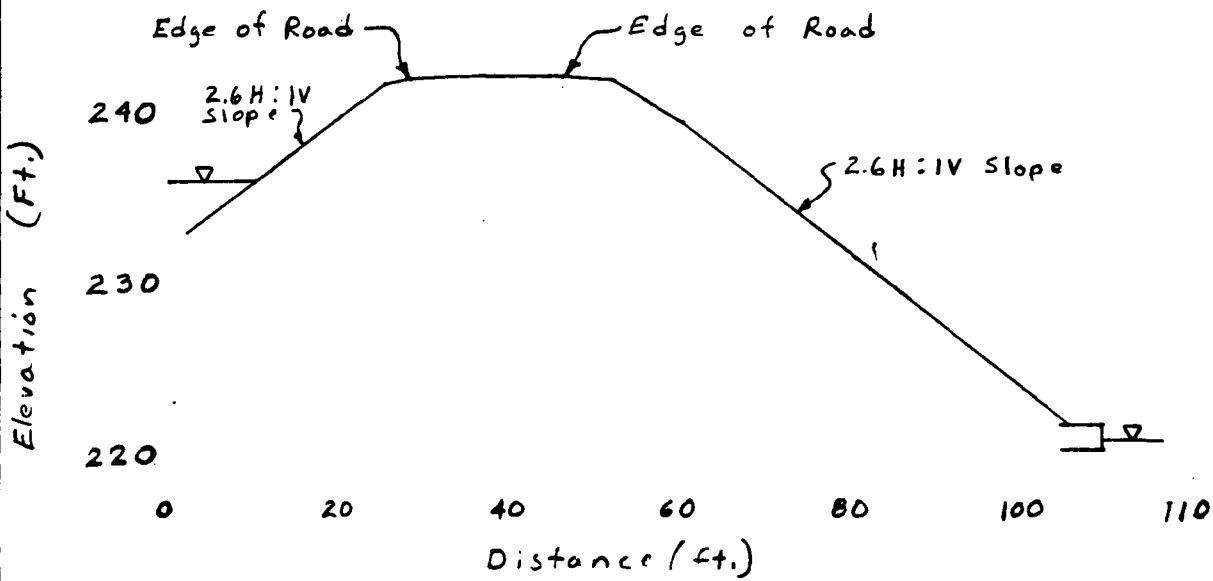


PLATE 7

APPENDIX II
PHOTOGRAPHS

CONTENTS

- Photo 1: Spillway Adjacent to Right Abutment
- Photo 2: Downstream Area of Spillway
- Photo 3: Control for Reservoir Drain
- Photo 4: Outlet of Reservoir Drain
- Photo 5: Downstream Embankment (Looking-Right)
- Photo 6: Sparse Vegetation on Downstream Embankment
- Photo 7: Eroded Toe of Dam
- Photo 8: Residential Property on Left Side of Downstream Channel

Note: Photographs taken 27 October 1980.

NAME OF DAM: LAKE HERITAGE DAM

LAKE HERITAGE DAM



PHOTO 1. Spillway Adjacent to Right Abutment



PHOTO 2. Downstream Area of Spillway

LAKE HERITAGE DAM



PHOTO 3. Control for Reservoir Drain

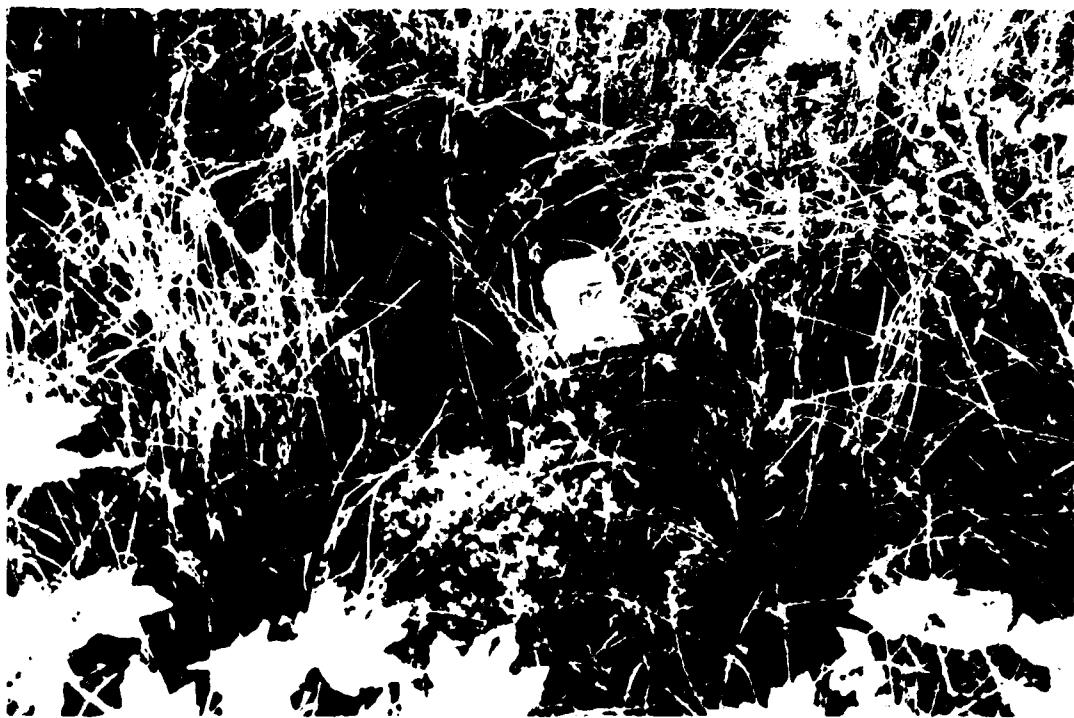


PHOTO 4. Outlet of Reservoir Drain (Beneath Hat)

LAKE HERITAGE DAM



PHOTO 5. Downstream Embankment (Looking Right)



PHOTO 6. Sparse Vegetation on Downstream Embankment

LAKE HERITAGE DAM



PHOTO 7. Eroded Toe of Dam (Sewage Treatment Plant on Right)

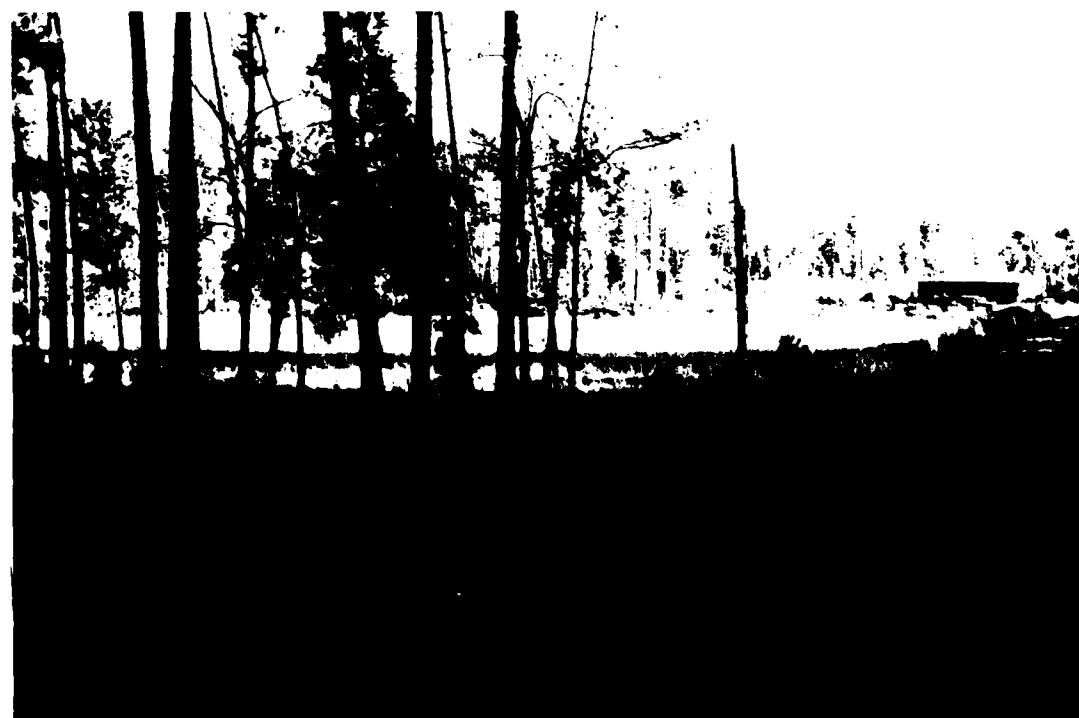


PHOTO 8. Residential Property on Left Side of Downstream Channel

APPENDIX III
VISUAL INSPECTION CHECK LIST

**Check List
Visual Inspection
Phase 1**

Name of Dam	Lake Heritage Dam	County	<u>Caroline</u>	State	<u>Virginia</u>	Coordinates	Lat.	<u>3800.2</u>
							Long.	<u>7733.2</u>

Date of Inspection 27 October 1980 Weather Clear Temperature 50° F.

236.3 T.B.M.* Tailwater at Time of Inspection 221.6
ft. ft. T.B.M.*

*Elevations were referenced to a Temporary Bench Mark (T.B.M.) located on the outside rim of a water manhole near the intersection of Kent Drive and Heritage Drive. The

Inspection Personnel: Michael Baker, Jr., Inc.:

David J. Greenwood
Larry A. Diday
David W. Hupe

Virginia State Water Control Board:

Ed Constantine

Mr. Robert Oberbrockling -
Manager, Lake Land'or
Property Owners Association.
Meeting before inspection.

Dave W. Hupe _____ Recorder

EMBANKMENT

Name of Dam: LAKE HERITAGE DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	A tar and chip roadway runs along the crest of the dam. The top of dam elevation varies by approximately 0.7 ft. along the crest of the dam. No significant horizontal misalignment was observed.	
RIPRAP FAILURES	The upstream embankment slope is riprapped and in good condition.	

EMBANKMENT

Name of Dam: LAKE HERITAGE DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	These junction areas are not eroded.	The junction areas do not require riprap, however, the roadway drainage channels on the right side of the dam that drain toward the spillway area should be monitored for erosion so that the junction areas are not eroded.
ANY NOTICEABLE SEEPAGE	The toe area of the dam is very swampy.	This is believed to be related to the runoff that drains left to right along the toe.
STAFF GAGE AND RECORDER	None present	
DRAINS		No evidence of an internal drainage system was found during the inspection.

Name of Dam: LAKE HERITAGE DAM

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The conduit is an 18 in. corrugated metal pipe.	The design plans show metal seepage collars but a construction photograph shows concrete collars.
INTAKE STRUCTURE	The lake drain structure was submerged at the time of inspection.	
OUTLET STRUCTURE	The lake drain outfall was submerged 0.7 ft. in a pool of standing water. The area is overgrown with high weeds and is not protected with riprap.	The outlet structure stilling pool should be riprapped.
OUTLET CHANNEL	The area is choked with small trees and high grass. Further downstream it is wooded.	The area should be cleared of overgrowth and maintained.
EMERGENCY GATE	The emergency gate is an 18 in. gate valve, according to the design plans. The control tower and stem are in very poor condition with corrosion. The tower shakes by hand and appears weak. It is doubtful if the valve could be operated.	The gate valve should be operated periodically and the control tower and stem should be repaired or replaced with non-corrosive materials.

Name of Dam: LAKE HERITAGE DAM

UNGATED SPILLWAY

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CONCRETE WEIR	The weir is 29.9 ft. wide, 4 ft. high and 12 in. thick.	There are no indications of spalling concrete.
APPROACH CHANNEL	The approach channel is well riprapped and not clogged.	
DISCHARGE CHANNEL	The discharge channel is paved with concrete (road across spillway) and also paved further downstream. The right side is lined by a concrete block retaining wall (leaning slightly into the discharge channel). The left side is riprapped. Concrete and riprap has been dumped into the discharge channel well downstream. The riprap downstream shows some signs of washout from previous storms.	The riprap on the left side of the channel should be choked off with finer material. The concrete block wall should be checked periodically for signs of movement or deterioration. The downstream riprap size should be checked against the design velocity size gradation and larger riprap installed as required.
BRIDGE AND PIERS	N/A	

Name of Dam: LAKE HERITAGE DAM

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed	
OBSERVATION WELLS	None present	
WEIRS	None present	
PIEZOMETERS	None present	
STAFF GAGE	None observed	A staff gage should be installed to monitor reservoir levels above the normal pool.

Name of Dam: LAKE HERITAGE DAM

RESERVOIR

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
SLOPES	The slopes are very gentle and generally wooded with some residential development and open grassy spots. The banks of the reservoir are well vegetated with medium to tall grasses and some trees. No significant erosion was noted.	The area is part of the residential development called Lake Land'or.
SEDIMENTATION	Soundings taken indicate the water depth to be 12 ft. at a point about 100 ft. offshore at the center of the embankment.	The extent of sedimentation is not expected to be significant.

Name of Dam: LAKE HERITAGE DAM

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No obstructions or debris were observed. The downstream channel is the old stream and is generally wooded.	
SLOPES	The gradient is about 0.5%.	
APPROXIMATE NO. OF HOMES AND POPULATION	A sewage treatment plant is located immediately downstream of the dam. No homes are located below the dam.	According to the Land'or Development map, two lots have been sold for homes on the left side of the downstream embankment.

APPENDIX IV
GENERAL REFERENCES

GENERAL REFERENCES

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NAME OF DAM: LAKE HERITAGE DAM

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NAME OF DAM: LAKE HERITAGE DAM